

Claims

1. A quality-of-service (QoS) reservation method for managing network resources and/or service parameters needed for symmetric real-time multimedia applications and/or data services running on a mobile node (106a) and a correspondent node (106c) by signaling resource control information along specific routing paths between these nodes (106a, 106c), said method comprising the steps of
- 10 - embedding (S1) resource control information to be transmitted between the mobile node (106a) and the correspondent node (106c) in an message (400) which is sent via the routing path of the reserved connection for these nodes (106a+c) and
 - 15 - disseminating (S2) resource control information between the mobile node (106a) and the correspondent node (106c) by using the same routing path (alternative #1) through the network (104) in both directions.
- 20 2. A method according to claim 1, characterized in that the mobile node (106a) initiates (S3a) a resource reservation request message indicating the demand for a predefined amount of network resources simultaneously for both directions.
- 25 3. A method according to claim 1, characterized in that the correspondent node (106c) initiates (S3b) a resource reservation request message indicating the demand for a predefined amount of network resources simultaneously for both directions.
- 30 4. A method according to anyone of the claims 2 or 3, characterized in that

the initiator (106a/c) of the resource reservation request message generates (S4) a unique reservation identifier (ID) associating the bidirectional connection to achieve a specific forwarding behaviour which remains unchanged during the lifetime of the associated flow.

5. A method according to anyone of the claims 2 to 4, characterized by the following steps:

- allocating (S5) network resources by using resource control information piggy-packed in an IP datagram (400),
- monitoring (S6) these network resources or
- simultaneously doing both (S5+S6) at the same time for both directions of the resource reservation request message, wherein resource control information for both directions of the reserved routing path is embedded in the same IP datagram (400).

6. A method according to anyone of the preceding claims, characterized in that

- resource control information for each direction of a reservation is piggybacked (S7) via resource information elements (400a+b) that are a part of the header extension (401c+d, 401c'+d') of the IP datagram (400), wherein each resource information element (400a+b) represents either a resource attribute along the reserved routing path, associated with a quantifiable resource metric for either one or both directions of the flow, or a flow attribute for an individual flow or flow aggregate, associated with quantifiable and non-quantifiable flow context information either for one or both directions of the flow.

7. A method according to claim 6, characterized in that

said resource information elements (400a+b) describe resource control information for upstream direction from the initiator

towards the receiver or downstream direction from the receiver towards the initiator of a resource reservation request message or for both directions together, wherein upstream and downstream direction are uniquely identified by the mobile node (106a) and the correspondent node (106c) due to their role in the reservation procedure either as initiator or receiver of a resource reservation request message.

8. A method according to claim 6,

characterized in that

said resource information elements (400a+b) are organized in a modular fashion for each flow, wherein the node (106a or 106c) that originates the resource control information determines (S8) the number of resource information elements (400a+b) to be placed into an IP datagram header (401c+d, 401c'+d').

9. A method according to anyone of the preceding claims, characterized in that

each resource information element (400a+b) comprises a field (503) for the monitored attribute value and attribute requirement specification fields (504, 505) specifying resource-attribute-specific flow requirements, which are described by an upper threshold defining the maximum value and/or a lower threshold defining the minimum value for the respective resource attribute.

10. A method according to anyone of the preceding claims, characterized by the following steps:

– simultaneously monitoring (S9a) information about available resources for both directions of the reservation along the reserved routing path (alternative #1) between the mobile node (106a) and the correspondent node (106c),

- for every node (105b+c) along the reserved routing path (alternative #1), determining (S9b) actual resource attribute values for up- and downstream direction,
- if at any node (105b+c) along the reserved routing path (alternative #1) a monitored resource attribute either for up- or downstream direction or for both directions has a value which is less than the correspondent monitored attribute value that is carried in the IP datagram header, assigning (S9c) the new value to the resource information element (400a/b) of the IP datagram header, which enables the receiver of the resource control information to determine (S9d) current resource values for both directions.

11. A method according to anyone of the preceding claims, characterized by the following steps:

- sending (S10a) a resource reservation request message describing a set of attribute requirement specifications and controlling (S10b) the resource allocation procedure either for one or both directions of the resource reservation by either the mobile node (106a) or the correspondent node (106c),
- based on such a resource reservation request message, determining (S10c) resource attribute values that should be allocated for the upstream direction, the downstream direction or both directions at the same time by every forwarding node (105b+c) along the reserved routing path (alternative #1).

12. A method according to anyone of the preceding claims, characterized in that resource control information for different bidirectional flows is piggy-packed (S11a) in the same IP datagram (400), wherein for each flow a reservation identifier information element referring to additional flow and resource information elements (400a+b) in the header of the IP datagram (400) is

attached (S11b) to the IP datagram header and the grouping of reservation identifiers and other resource information elements (400a+b) determines (S11c) the membership of this information to a specific flow.

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13. A method according to anyone of the preceding claims, characterized in that either the mobile node (106a) or the correspondent node (106c) determines (S12) on the IP layer whether bidirectional or unidirectional resource control information can be inserted into an IP datagram (400) that is ready to be transmitted to the networking interface or whether a separate IP datagram (400) needs to be generated for that purpose.

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14. A method according to claim 13, characterized in that resource control information is placed in any IP datagram (400) which follows the reserved routing path (alternative #1) between the initiator and the receiver of a resource reservation request message.

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15. A method according to anyone of the preceding claims, characterized by the step of recognizing (S13a) conditions of insufficient resources along the routing path for upstream and downstream direction at the correspondent node (106c) by comparing (S13b) monitored attribute values with the attribute requirement specifications in the resource information elements (400a+b) of an arriving IP datagram (400).

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16. A method according to anyone of the preceding claims, characterized by the step of setting (S14) monitored resource attribute values of specific resource information elements specified in the IP datagram

header (400) to zero in case one or more forwarding nodes (150b+c) do not support these resource attributes.

17. A method according to anyone of the preceding claims,
5 characterized by the step of
setting (S15) those attribute values carried in the IP data-
gram header to zero that enable reservation end points to
easily interpret the situation of routing asymmetry if up-
and downstream path for a bidirectional reservation do not
10 follow identical routes at a specific routing node (105b/c)
along the reserved routing path (alternative #1).
18. A method according to anyone of the preceding claims,
characterized by the steps of
- 15 - interpreting (S16a) resource reservation request messages
with the value zero for one or more attribute requirement
specifications as explicit release messages by the forward-
ing nodes (105b+c) along the reserved routing path
(alternative #1) and by the initiator or receiver of the
20 resource reservation request messages and
- associating (S16b) the values of these attribute require-
ment specifications with the removal of flow-specific res-
ervation state information in the forwarding nodes (105b+c)
along the reserved routing path (alternative #1).
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19. A method according to anyone of the preceding claims,
characterized by the steps of
- interpreting (S17a) resource reservation request messages
with a value unequal to zero for one or more attribute re-
30 quirement specifications as explicit setup messages by the
forwarding nodes (105b+c) along the reserved routing path
(alternative #1) and by the receiver (106c) of the resource
reservation request messages and
- associating (S17b) the values of these attribute require-
35 ment specifications with the installation of flow-specific

reservation state information in the forwarding nodes
(105b+c) along the reserved routing path (alternative #1).

20. A method according to anyone of the preceding claims,
5 characterized by the steps of
- piggy-packing (S18a) a flow information element specifying the type of reservation as either bidirectional or unidirectional in the IP datagram header (401c+d, 401c'+d') of a reservation setup message,
 - 10 - interpreting (S18b) this flow information element at the forwarding nodes (105b+c) along the reserved routing path (alternative #1) to ensure correct installation of reservation state information.